AMENDMENTS TO THE SPECIFICATION

Page 1, prior to line 1, insert the following title and paragraphs:

--**PRIORITY CLAIM**

This is divisional application of U.S. Serial No. 10/049,097, filed February 5, 2002, which is a U.S. national stage of application No. PCT/CH00/00401, filed on July 21, 2000. Priority is claimed on that application and on the following application:

Country: Germany. Application No. 19936501.6, filed August 5, 1999.

Page 1, line 4, insert the following title:

BACKGROUND OF THE INVENTION

Page 1, line 17, amend the paragraph as follows:

~~The patent~~ German Patent DE 35 32 499 C1 describes a device for hydraulic expansion of a length of pipe by using a plug-like cylindrical probe which can be introduced into the pipe and, using at least a pair of sealing rings spaced a distance apart, forms a circular space which is filled with compressive medium for the purpose of expanding the tube~~, each~~. Each of the sealing rings is situated in a ring-shaped groove with a u-shaped in cross-section, in the probe and ~~at the start, on~~ initially upon introducing the probe into the tube, has an outer diameter which at most is the same as the outer diameter of the probe. Before starting the expansion process, in order to seal the ring-shaped gap between the probe and the tube, compressive medium is introduced into the ring-shaped grooves via a feed pipe connected to the medium supply line and applies compressive force radially to the sealing rings. The feeding of the compressive medium to the ring-shaped space is performed solely by way of at least one of the grooves and is controlled by a sealing ring acting as a valve, which closes off an opening between the groove and the ring-shaped space until it has achieved its sealing function by elastic expansion. That groove is provided with at least one inclined slit at its

edge ~~neighbouring~~ neighboring the ring-shaped space. If the pressure in the ring-shaped space between the two seals is increased, the wall of the tube begins to expand in this region.

Page 1, line 34, please amend the paragraph as follows:

This internal high pressure forming or hydroforming process is finding ever increasing application in the automobile industry as an ~~economic~~ economical means for manufacturing car body components. Mainly steel tubes are employed as starting material. The final contour of the component to be shaped this way is generally much more complicated than the simple circular cross-section of the starting material. As a rule, the HIPF process results in regions which are much more heavily deformed than other regions and which are correspondingly thinner. If these regions are subjected to a high degree of loading in use, the initial sheet must be sufficiently thick; this however results in an unnecessary amount of material in the less heavily formed regions. This disadvantage is contrary to the requirement of obtaining the lowest possible weight in the component.

Page 2, line 15, amend the paragraph as follows:

HIPF processes using extruded sections are employed mainly to be able to produce high precision parts. To that end the present state of the art tends to make the shape of the initial section as close as possible to that of the final section in order to employ relatively small degrees of deformation in the HIPF-process. In particular with curved components that are to be bent in advance or where the section cross-sections feature sharp corners, this approach is usually not successful. Also, attempts to keep the degree of deformation small generally results in its non-uniform distribution. As a result - and due to the pre-shaping from the bending process – spring-back effects are produced causing the desired precision to be achieved only in exceptional ~~case~~ cases using that process. Likewise as a rule, sharp corners which exhibit a large ratio of wall thickness to outer radius ~~can not~~ cannot be filled out using this process.

Page 2, line 31, please amend the paragraph as follows:

In view of the above, the object of the present invention is to provide a specific cross-section of an extruded section which achieves a ~~favourable~~ favorable distribution of deformation in the HIPF-process; the elastic spring-back of the component after removal from the HIPF shaping tool should be ~~minimised~~ minimized and dimensional accuracy achieved to the desired degree of precision.

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Page 3, line 3, please amend the paragraph as follows:

In accordance with the present invention, in order to shape-form the initial section featuring at least one corner region, the wall sections adjacent to the corner region are pre-shaped in a curved manner - as viewed in cross-section - counter to the direction of applied pressure, and subsequently ~~re-shaped~~ reshaped by applying the high internal pressure of the medium that can flow in the direction in which the pressure is applied, displacing the corner region~~; if~~ . If there are at least two corner regions present, the wall lengths between the corner regions are accordingly pre-shaped counter to the direction in which the pressure is applied and ~~re-shaped~~ reshaped – likewise by applying the high internal pressure of the medium that can flow, displacing the corner regions in the direction in which the pressure is applied.

Page 3, line 13, please amend the paragraph as follows:

In practice the ~~re-shaping~~ reshaping will mainly concern angles that are almost right angles, whereby the section cross-sections need not have rectangular shaped contours. However, other sizes of angle can be ~~re-shaped~~ reshaped, in particular corners running to a peak with angles of less than 45°.

Page 3, line 18, please amend the paragraph as follows:

It has been found ~~favourable~~ favorable to carry out the displacement of the corner region in the direct-ion of the line bisecting the angle or its line of symmetry. In the initial section this corner region should also be of greater thickness.

Page 4, line 11, please amend the paragraph as follows:

The inwards pointing curvature of the cross-section is important here; especially with regard to cross-sections whose section walls are curved in the final component, it is ~~emphasised~~ emphasized that it depends on the relative curvature and not on the absolute curvature. This is so because in the end this determines whether the contour of the initial section - with respect to the final contour - exhibits oversizing or undersizing, through which the ~~behaviour~~ behavior of the component in the described shape-forming process is controlled.

Page 4, line 18, please amend the paragraph as follows:

By doming or similar cross-sectional curvature it is possible to achieve local oversizing; in contrast to domed oversizing on the outside of the section, this doming does not cause any problem on placing the component into the ~~mould~~ or on closing the ~~mould; in~~ mold. In the HIPF process the oversizing causes local compression of the material in the direction along the periphery of the section. As a result of the constant volume of ~~aluminium~~ aluminum, internal com-pressive stresses are created in the longitudinal direction of the section, which on removing the component from the ~~mould~~ mold results in corresponding spring-back in the longitudinal direction. By providing lengths of section with local undersizing, the material is made to stretch in the peripheral direction of the section at these places during the HIPF process. Due to the above mentioned plastic constant volume of ~~aluminium,~~ aluminum tensile stresses are induced in the longitudinal direction of the section, which on removing the component from the ~~mould~~ mold, results in corresponding spring-back in the longitudinal direction.

Page 4, line 31, please amend the paragraph as follows:

A suitable distribution of stretching and compressive zones ~~minimises~~ minimizes the resultant overall spring-back, so that after the HIPF process the components obtained are accurate in shape.

Page 4, line 34, please amend the paragraphs and sub-paragraphs as follows:

In order to ~~re-shape~~ reshape sharp corners at the same time avoiding excessive local degrees of deformation at the corners the following measures are taken:

- pronounced thickening of the section corners prevents irreversible bending at the start of the HIPF process;
- by providing dome-like curvature in the cross-section in the immediate vicinity of the thickened section corners it is possible to reduce, even completely eliminate the local stretching of the material necessary to ~~re-shape~~ reshape small corner radii.

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Page 5, line 19, please amend the paragraph as follows:

It has been found ~~favourable~~ favorable for such a bent region to exhibit a contour that is in the form of part of a circle, the arc length of which is defined as the distance between a pair of flanges that delimit the related corner regions. That distance is given by the length of section side wall less the lengths of the flanges in the related corner region – which, depending on the cross-sectional shape of the extrusion and the distribution of wall-thickness may also be unequal – and less the distance defined by the projection of the gap between the initial section and the contour of the shaping tool mould accommodating the component.

Page 5, line 32, please amend the paragraph as follows:

In the case of an initial section of cross-section in the form of an equilateral triangle, that distance between the flanges should be e.g. about three times the length of the flange. In this case the height of doming, i.e. the distance between the curvature in the form of part of a circle and a straight line joining the flanges, should correspond approximately to the thick-ness of the section wall.

Page 6, line 1, please amend the paragraph as follows:

~~On~~ When using extruded ~~aluminium~~ aluminum sections it is possible to avoid the work step involving pre-forming of the sections in that the initial section is manufactured in the desired ~~favourable~~ favorable pre-bent shape. Apart from the savings associated with the pre-forming, at the same time a high degree of process reliability is achieved on bending or on closing the HIPF shaping tool.

Page 7, line 21, please amend the paragraph as follows:

After the HIFP-shaping step, the result is a hollow section 18 of larger cross-section; the middle region of the wall contour 24 of the section walls 22_a, as shown in figure 3, lie against the walls 15 of the shaping tool; towards the section corners 19, however, the corner regions 28 of the hollow section 18 maintain a distance i from the walls - the distance i increasing the closer to the corner and forming an angular space 29 ~~those~~ whose flanges ~~tapers~~ taper away from the corner of the wall contour 15 i.e. the corner is not filled out.

Page 7, line 28, please amend the paragraph as follows:

In order to avoid such undesirable shaping and to obtain, by means of HIFP-shaping, a final or hollow section 18a as shown in figure 5 that corresponds to the ideal hollow section 18_i, an initial

section 16_n according to figure 4 is extruded with section walls 22_n that, in cross-section, are curved inwards as a part of a circle over a central region 30 of length e (indicated in figures 6, 7 by cross-hatched lines); the radius r of curvature K of the outer surface 32 of the curved region 30 corresponds approximately to length ~~e; in~~ . In figure 6 for reason of clarity the curvature K is extended beyond the section wall 22_n. Running from the corners 19 of the section on both sides are linear wall sections of lengths f as flanges of the corner angle w of 120° or of the corner regions 28_n which are thicker than the wall thickness b. The distance between the corner regions 28_n - defined by the flanges 34 - defines the arc length of the curvature K or the above mentioned length e and measures here approximately three times the length f of the flanges 34. The magnitude h of the crown formed by the curved outer contour or outer surface 32 of the section wall 22_n corresponds approximately to the wall thickness b, or is slightly larger. As a result of the radius of the ~~levelling~~ leveling of the curved lengths 30 of section walls 22_n the high internal pressure pushes the described corner regions 28_n of angle w into the corresponding corner of the ~~mould 14~~ mold, with the result that the angular spaces 29 in the ~~mould~~ mold in the example shown in figure 3 ~~is~~ are avoided. The corners are pushed in the directions determined by the corner middle lines N.

Page 8, line 10, please amend the paragraph and sub-paragraphs as follows:

For reasons of clarity it should be pointed out that requirement of the height h of the crown to be approximately the same as the thickness b of the wall applies only to the example chosen here; essential for the shape of the curvature K is its length or length of arc y (figure 7). The arc length y determines whether the length of section wall 22_n in question is greater or smaller than the length of sidewall a. If for example the length in question is to be greater by an amount u (if it is smaller, then u is negative), then the arc length must be as follows

$$y = e + 2i_1 + u/2 \qquad (1)$$

where i_1 is a distance from the corner derived from the associated angle w and the local gap t according to the following relationship

$$i_1 = t * \tan(w/2). \qquad (2)$$

Further, taking into account the length of flange f:

$$e = a - 2(f + i_1). \qquad (3)$$

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Page 9, line 3, please amend the paragraph as follows:

The height of crown h can be determined with the aid of an iteration method. Also, when designing a cross-section of an extrusion in practice using a CAD ~~programme~~ program, the length of arc y of a curve is known and can be easily adjusted in order to arrive at the desired dimension.

Page 9, line 14, please amend the paragraph as follows:

A section frame 40 shown in the form of a sketch in figures 8, 9 is slightly curved along its length n of e.g. approximately 2000 mm and features a strut 41 at its side. At its ends 42 and in the middle region 43 the section frame 40 is welded to other components which are not shown here. In order to be able to employ a laser welding method, it is necessary to specify a tolerance of approx. ± 0.5 mm for the line of bending. Also the section frame 40 is made out of an ~~aluminium~~ aluminum extrusion which is first bent and then given its final shape in an HIPF process.

Page 9, line 22, please amend the paragraph as follows:

The contour 15 of the ~~mould~~ mold space 14a in the HIPF tool 10a in figure 10 corresponds exactly to the desired outer contour of the finished section frame 40. The bending process is chosen such that the slight curvature in the section frame 40 due to the change in cross-section resulting from the bending process can be neglected.

Page 9, line 32, please amend the paragraph as follows:

After bending, the component in question is introduced into the HIPF shaping tool 10a. By increasing the internal pressure, first the three section flanges or walls 44, 45, 46 come to rest on the wall contour 15. The corners with smaller radii are at first not changed in shape. On ~~increas-ing~~ increasing the internal pressure further, the corner regions 48 are shape-formed. As a result of the friction between the tool 10a and the part 16, the tensile deformation in the direction of the periphery of the section which is necessary for filling out the corners is restricted to the section corners 48 and the surrounding regions. Because of the constant volume of ~~alumin-ium~~ aluminum under plastic deformation, that deformation results in internal tensile stresses at the corners 48 in the longitudinal direction. The resulting moment referring to the main axis of bending A does not disappear as the internal tensile forces are mainly on the right side. On removing the part 38 from the tool 10a there is therefore elastic spring-back which, after the HIPF process causes the section frame 40 to exhibit a smaller curvature than that prescribed by the contour 15 of the tool wall. The required tolerance can therefore not be met.

Page 10, line 10, please amend the paragraphs and subparagraphs as follows:

The spring-back effects described above can be counteracted by designing the initial section 38_n as in figure 12. In order to achieve this, the moment around the main bending axis A caused by the internal stresses must be reduced or eliminated i.e. to the right of this main bending axis A one must induce mainly internal compressive forces instead of internal tensile forces or, left of the main bending axis one must induce mainly internal tensile forces. This is achieved by means of the cross-section of the initial section 38_n shown in figure 12 due to the following methods of design:

- The length of arc of the upper section wall 46_n remote from the strut is oversized with respect to the final contour with the result that in the HIPF process compression in the direction of the periphery occurs at this place and, as a consequence thereof, the desired internal ~~compress-ive~~ compressive forces are induced in the longitudinal direction; the oversizing is in the form of doming towards the interior, in order to prevent ~~deform-ation~~ deformation on closing the tool 10_a.

- The upper section wall 45_n close to the strut is undersized with respect to the final contour with the result that in the HIPF process stretching of the material occurs at this place in the direction of the periphery and, as a consequence thereof, the desired internal tensile forces are induced in the longitudinal direction.

- The base wall 44_n is - as viewed in cross-section - domed from the corner regions 48, this - as shown in figure 6 for a triangular section - in order to simplify the shape-forming of the corners 48_n.

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